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WITNESS my hand this
Twenty-eighth day of June 2000

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SPECIFICATION

METHOD AND APPARATUS FOR TREATING ATTENTION DEFICIT DISORDER (ADD).

11 Aug, 1999

BACKGROUND

The general public has taken to understand that a person with **Attention Deficit Disorder (ADD)** has an inability to sustain attention, whereas the disorder also covers hyperactivity and impulsiveness. The more correct expression for the disorder is **Attention Deficit Hyperactivity Disorder (ADHD).**

The clinical definition of **ADHD** also provides categories for a person who has all these characteristics in some measure, such as; the **predominately inattentive** type, the **predominately hyperactive/impulsive** type or the **combined** type - one who has characteristics of both of the preceding types.

To be diagnosed as one of these types requires a behaviour that is persistent and established over a long period, well beyond what is seen sporadically in most children shouldering the stress of modern living.

Estimates from **ADHD** associations suggest that **ADHD** effects 5% of the World's population. This makes **ADHD** a grave human problem with a substantial global economic impact.

This invention has its genesis in the similarities between those afflicted with **ADHD** and those afflicted with reading disorders such as **Dyslexia.**

For example, those with **Dyslexia** are often misdiagnosed to be forgetful, inattentive and unintelligent. Those with **ADHD** are also misdiagnosed to be so.

Dyslexia has a strong hereditary component. So has **ADHD.** Modern neurophysiological research using non invasive techniques such as (PET) Positron Emission Tomography and functional Magnetic Resonance Imaging (fMRI), have shown that those with **Dyslexia** do not use the same portions of their brain as non-Dyslexics.

Similarly, PET and fMRI techniques have shown that those with **ADHD** do not use the same portions of their brain as those without **ADHD.**

The provisional patent lodged on the 15th June 1999 by the present inventor, receipt number 74002791, entitled; "Vision Disorder Remediation and Enhancement Device", **(VDRED)**, recalls prior art that has had some success in using a simple mechanical device to stimulate the visual cortex as part of an overall treatment of non-retinal visual disorders such as **Dyslexia**.

By chance, a small portion of these patients was also diagnosed as having **ADHD** prior to treatment for **Dyslexia.**

After treatment that involved the stimulation of the visual cortex contemporaneously with a sustained cognitive effort by the

patient, this small portion of patients all lost their symptoms of **Dyslexia** as well as their symptoms of **ADHD.**

The reasons that it was possible to treat an **ADHD** patient through a visual remediation are clear to the inventor of this application. As pointed out in the lodged provisional patent for **VDRED** mentioned previously in this application, the Magnocellular pathways of the visual system were debilitated in patients with visual Dyslexia. Patients who have debilitated Magnocellular pathways can develop **ADHD.**

How this is so can be demonstrated when those <u>without</u> debilitated Magnocellular pathways reach their own (higher) limits. This occurs - as an example - when a passenger without such debilitations is driven quickly down a narrow road with hedges. This passenger cannot look at the hedges flashing by for very long without experiencing an acute visual discomfort.

This discomfort is due to overload of the Magnocellular pathway system, the system that has evolved for processing fast moving objects.

Persons with debilitated Magnocellular pathways reach their limits well before speeding hedges. They reach their limits constantly during normal everyday life, when reading or looking at everyday objects, which to the person with **ADHD,** are visually demanding to the point where discomfort is experienced - perhaps not the level induced by speeding hedges - but discomforting nevertheless.

Some individuals persevere by themselves with what gives them discomfort. This is tantamount to a self imposed life long cognitive exertion regime that is a building block in the treatment that is covered in provisional patent for **VDRED** as previously mentioned in this application. In time, sometimes years later, their visual systems become stronger, reducing their discomfort to the point where they never develop **ADHD**.

Just as some people approach everyday stairs as an athletic exercise and some seek the path of least effort, so it is with neurophysiological debilitations. It is an issue of personality, of character and a matter for the psychologist. *Some become stronger through engagement. Others stay weak through avoidance.*

Whether through avoidance or the degree of debilitation, the tendency to look away after short time intervals becomes ingrained and habitual. That person eventually suffers from **ADHD.** They essentially lose the choice of becoming stronger through engagement and need the help of inventions such as the subject of this application.

The similarity between **Dyslexia** and **ADHD** was mentioned earlier in this application. It was also mentioned that a patient with visual **Dyslexia**, who was also diagnosed as having **ADHD,** was essentially cured of both through a treatment that has vision as its prime objective.

In the same way that **VDRED** takes the prior art of treating **Dyslexia** to a new level, by recognizing and accommodating the '*Continuum of Dyslexia*' (this inventor's expression) through

innovative modern technologies, so this invention is based on the discovery that **ADHD** has its own neurophysiological basis and it own continuum.

ADHD develops in reaction to sensory discomfort caused by a neurophysiological debilitation, whose causes are part genetic, part life experience and part exposure to the environment.

The debilitation which causes **ADHD** to develop, can be in the neurophysiological areas of the brain predominantly concerned with the visual, the auditory, the somatasensory or the kinesthetic, (sight, sound, touch and awareness of position/movement of muscles.)

The rehabilitation of the **ADHD** patient is made possible by using the diagnostic and remediation capabilities of **VDRED.**

1) Diagnosis.

As previously mentioned in this application, **VDRED** provides an integration with powerful non-invasive diagnostic machines such as the PET and the fMRI. This integration enables the Clinician to 'see' the brain thinking.

VDRED provides a multi-sensory diagnostic program that is used by the **ADHD** patient whilst the patient is undergoing a PET or fMRI scan, in order to establish the neurophysiological debilitation profile of that patient.

The **VDRED** diagnostic program is parametric, enabling it to be adjusted, labeled and identified, thereby becoming patient specific. It also enables the software to

become statistically analyzed and become part of the system reference data bank.

The diagnostic program focuses on the visual, phonological, auditory, somatasensory and kinesthetic regions in the brain.

VDRED will store the neurophysiological data from the PET or fMRI to use it as the base for that patient's treatment and as a base from which a generic profile will be developed.

The Clinician's **VDRED** screen will show the neurophysiological data alongside the patient's multi-sensory responses. Those responses will also be statistically graded with respect to age, gender and aptitude.

2) Remediation.

The neurophysiological debilitation profile of the patient is used to select the most appropriate stimulation and cognitive exertion regimes.

Due recognition is given to the psychological and behaviourial needs of the **ADHD** patient. A greater human influence is sought through the greater involvement of the Clinician, as well as a greater intrinsic interest in the treatment through a greater use of technological 'wizardry'. Hence the total experience is to be more strongly biased towards entertainment.

There will be less use of the virtual reality goggles during the remediation phase as these increase the sense of isolation from the Clinician.

The cognitive tasks appropriate to the neurophysiological debilitation profile will focus on each sense separately. These cognitive exertion treatment 'blocks' will initially be short but progressively increase in length to approximate the times employed for patients being treated for **Dyslexia** but without **ADHD**.

Once each of the senses have been treated separately, the cognitive exertion treatment 'blocks' will be gradually integrated into groups comprising, sight, sound, touch and the motor functions according to the debilitation profile of the patient.

3) Confirmation.

The patient can be returned to the PET or fMRI for scanning to confirm that the improvements that have been made through treatment by **VDRED.**

The expense of using a PET or fMRI is such that these will be used mostly as an R & D tool to develop and refine the multi-sensory diagnostic and treatment software. When sufficient data is acquired through R & D, an effective diagnostic and remediation can be carried out by **VDRED** without the use of PET or fMRI.

Difficult-to-diagnose patients will employ **VDRED** integrated with PET and fMRI however.

PREFERRED EMBODIMENT

A preferred embodiment of the invention is shown in **Drawing 1**, which is similar to that shown in provisional patent for **VDRED** as mentioned previously in this application. This shows the patient sitting in front of and looking directly at a vertical flat screen whilst writing on a pad, inclined for comfort. The pad is integrated with the image on the monitor, such that the patient is able to write and draw on the pad, without having to look downwards and be able to see his or her drawing appear in the image on the monitor.

The adjustable power seat is not shown for reasons of greater clarity nor the parent sitting on the left-hand side of the patient, opposite to the clinician seated on the right-hand side of the patient.

The image on the screen has a graduated stimulation regime interposed with exercises whose purpose is to exert the maximum cognitive effort that the patient is able to muster.

The Clinician is shown sitting at the side looking at an inclined monitor, which displays not only the identical images that the patient sees, but also other information of interest to the Clinician. Such information would include but not be limited to, the name of the patient, some essential details on the patient, the number of the session, the elapsed time of the session, the elapsed time of each segment of the treatment, the combination of stimulation background and cognitive

exertion package being employed, and how the patient is progressing against the cumulative statistical profile of similar patients.

Preferably, there are high fidelity audio speakers on either side of the monitor. These in combination with the monitor, will provide a personalized audio-visual introduction and conclusion to the treatment session, as well as add an auditory element to the treatment. Apart from providing a more interesting dimension to the cognitive exercises in the form of supplementary noises, comments and melodies from time to time, the audio system would emit exercises intended to diagnose for the presence of any phonological impairment. If such an impairment is detected, then the Clinician would select a treatment from **VDRED** to include cerebello-vestibular remediation.

Drawing 2 shows a side view of the preferred embodiment. Powered seating with memory is shown that allows the patient to be positioned correctly without introducing fractal dimensional errors.

Also shown in **Drawing 2** is the monitor of the Clinician and an inclined keyboard in front of it. Behind the monitor screen of the Clinician but not shown in **Drawing 2** are input-output modules for the multi-sensory diagnostic devices that are used according to the neurophysiological profile of the patient.

To the right of the Clinician are the parametric control modules, which can modify and store the diagnostic and remediation software sub-sets appropriate to each patient.

A preferred embodiment of this present invention, is when the **ADHD** patient is diagnosed with 'virtual reality' goggles integrated

with **VDRED** and PET or fMRI as shown in **Drawing 3.** As previously mentioned, this embodiment enables a comprehensive diagnosis to be performed by exposing the **ADHD** patient to a systematic regime of visual, phonological, somatosensory and kinesthetic tasks such as is available by the present invention. This will provide a neurophysiological debilitation profile of the **ADHD** patient, from which an optimal sub-set of remediations can be recalled and used in the treatment program such as shown in **Drawing 1.**

Drawing 4 shows an **ADHD** patient undergoing preliminary auditory treatment. A program is shown in **Drawing 4** that exercises the cerebello-vestibular areas of the brain, (phonological) with an emphasis on left to right capabilities.

Sounds from different sources corresponding to the symbols on the screen are emitted. Each symbol corresponds to a particular frequency, starting from the highest on the left to the lowest on the right. The touch pad is configured to match the symbols on the screen. Whenever the patient rests his or her finger tips on a touch-pad row, the corresponding row on the screen is shadowed. Similarly an additional vertical shadow line appears when the finger touches a button. The 'cross' of shadow lines makes it unnecessary for the patient to look down at the pad.

After a few minutes of practice, sounds are emitted at random for frequency, source and left to right orientation, are introduced through the earphones. The patient tries to match them with a pad button push.

A successful match is accompanied by a pleasing audio and visual success exclamation mark and an increase in the running score that is shown digitally on the screen.

Those with phonological debilitations are unable to distinguish small time intervals between sounds as small as can be distinguish by those without debilitations.

Another portion of this treatment reduces the time interval between sounds to the limit of the **ADHD** patient's perception. If the patient correctly identifies the existence of two sounds, an auditory success exclamation mark is heard and the score is increased. This is progressively made more difficult over the series of sessions, until the patient is able distinguish auditory times intervals comparably small to those distinguished by those without debilitations.

The treatment then moves to phonemes, the basic building blocks of language. The software becomes language orientated, searching, interactive and entertainment orientated. After the full series of treatments, the **ADHD** patient's ability to distinguish phonemes is enhanced as well as the ability to read without discomfort.

Those with somatasensory debilitations are unable to distinguish time intervals between two consecutive touches as small as can be distinguished by those without any debilitations. The touch pad button areas as shown in **Drawing 4** have the capability of emitting a single vibratory pulse that the **ADHD** patient can feel. A somatasensory subset of treatment software that is part of **VDRED**, enables the patient to be diagnosed and exercised for debilitations of

touch. This particular treatment not only brings a patient closer to what is normal with respect to the smallest time interval that can be perceived between consecutive touches, but also diagnoses and treats that time interval when it is transmitted from left to right.

WE CLAIM:

1. An apparatus for treating **Attention Deficit Hyper Activity (ADHA)** comprising the presentation of computer generated visual images and audio inputs so as to strengthen the visual and phonological pathways of a patient and provide interactive work exercises on said images by means of external physical devices utilized by the patient.
2. An apparatus as claimed in claim 1 where an external device is preferably an interactive tablet upon which the writing of a patient can be seen in the said images as in claim 1.
3. An apparatus as claimed in claim 1 where the external device is preferably an interactive tablet with touch buttons that correspond with symbols on the screen.
4. An apparatus as claimed in claims 1, 2 3 where audio signals controlled by the Clinician are heard in the earphones worn by the patient that correspond with the same symbols as in claim 3.
5. An apparatus as claimed in claims 1,2, 3 & 4 where an audio or visual signal is produced that indicates to the

patient that the correct button corresponding with the audio signal in the earphones has been pressed.

6. An apparatus as claimed in claims 1,2,3,4 & 5 where the action of the Clinician can cause a perceptible 'tap' to be applied by a button onto the finger of the patient when that button is so activated by the Clinician.

7. An apparatus as claimed in claims 1,2,3,4,5 & 6 where the action of the Clinician can progressively reduce the time interval between 'taps onto the finger' to zero or near zero, on any button so equipped.

8. An apparatus as claimed in claims 1,2,3,4,5,6 & 7 where the time interval between 'taps on the finger' can be reduced to zero or near to zero between any two buttons, including those situated on either sides of the tablet so that one hand experiences the first 'tap' and the other hand experiences the second 'tap'.

9. An apparatus as claimed in claims 1,2,3,4,5,6, 7 & 8 whereby all the time intervals can be measured and recorded.

10. An apparatus as claimed in claims 1,2,3,4,5,6, 7, 8 & 9 whereby all the time intervals can coincidentally and exactly be accompanied by their corresponding audio inputs if so chosen by the Clinician.

11. An apparatus as claimed in claims 1,2,3,4,5,6,7,8 9 & 10 where an external device usable by the patient is able

to activate audio and visual responses by the insertion of objects that require a high degree of dexterity and coordination with two hands, so as to provide kinesthetic cognitive exertion by the patient.

12. An apparatus for enhancing the vision of a patient so as to better see fast moving objects moving at any angle towards or away from the patient, comprising of the same said apparatus as in claim 1 with same said visual images or other images with same said external physical interactive devices or other external physical interactive devices.

13 An apparatus as claimed in any of claims 1, 2, 3,4,5 & 12 where the images may be presented to the patient by means of helmet or goggles or eye glasses or any means other than by a computer monitor screen.

14 An apparatus as claimed in any of claims 1, 2, 3,4,5,6,7,8,9,10 11 & 12 where the visual and all other inputs presented to the patient and the patients reaction to them, are integrated with non invasive diagnostic devices such as a Positron Emission Tomography machine or a functional Magnetic Resonance Imaging machine capable of displaying real time visual representations of brain activity, preferably enabling a person other than the patient to simultaneously view the

vision field of the patient and the patient's corresponding brain activity.

15 An apparatus as claimed in any of claims 1,2,3,4,5, 12,13 & 14 where the visual images are preferably 2 or 3 dimensional and are preferably moving.

16 An apparatus as claimed in any of claims 1,2,3,4,5, 12,13,14 & 15 where the said visual images are preferably accompanied by sound which is available to the patient by means of earphones or hi-fidelity speakers or both.

17 An apparatus as claimed in any of claims 1,2,3,4,5,6,7 8, 9,10,11,12,13,14,15 & 16 where the said visual images, audio signals and all patient responses can preferably be transmitted via internet from a central location, uploaded and downloaded with a speed that is commercially viable for the operation of global clinics.

18 An apparatus as claimed in any of claims 1,2,3,4,5, 12,13,14,15,16 &,17 where the said images can preferably be adjusted for colour, colour brightness, colour gradation, contrast, shape, geometry, motion, direction, texture and sound by either by preprogrammed selection by the Clinician or any other person.

19 An apparatus as claimed in claims 1,2,3,4,5, 12,13,14,15 16 17 & 18 where the said images can

preferably be also viewed by any p[illegible]n other than the patient, simultaneously, separately, or at any subsequent time by means of a computer monitor, helmet, goggles or eye glasses.

20 An apparatus as claimed in claims 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18 & 19 where the said images can be viewed with any additional interposed visual information not visible to the patient during treatment.

21 An apparatus as claimed in claims 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 16 17, 18,19 & 20 where the additional interposed visual information as in claim 20 also provides the neurophysiological debilitation profile that the **ADHA** patient has before, during and after treatment.

22 An apparatus as claimed in claims 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20 & 21 which has the capability to diagnose and remediate debilitations involving the interaction between the left and right sides of the brain.

23 An apparatus as claimed in of claims 1,2,3,4,5,6,7,8,9,10 11, 12,13, 14,15,16,17,18,19, 20, 21 & 22 where the means of chosen viewing is only by computer monitor, a preferred further modification is to adjust the seat height and head rest of the patient so as

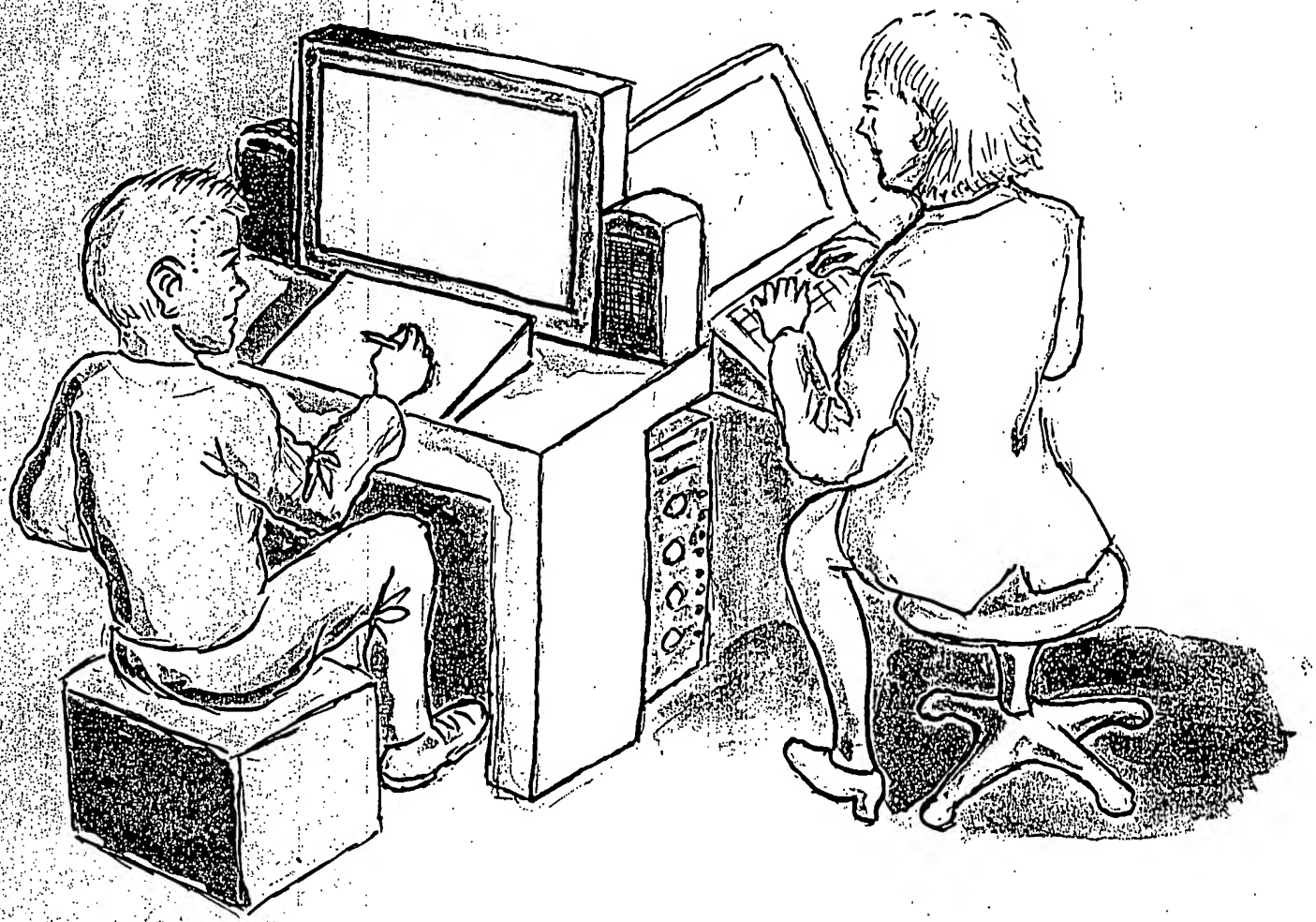
to place the eyes of the patient in a particular position relative to the computer monitor from which the simulating and exercising images will be presented.

Dimitri Caplygin 11 Aug 1999

VISION DISORDER REMEDIATION & ENHANCEMENT DEVICE. (VORE DEVICE)

GENERAL ARRANGEMENT

DRAWING (1)



DC
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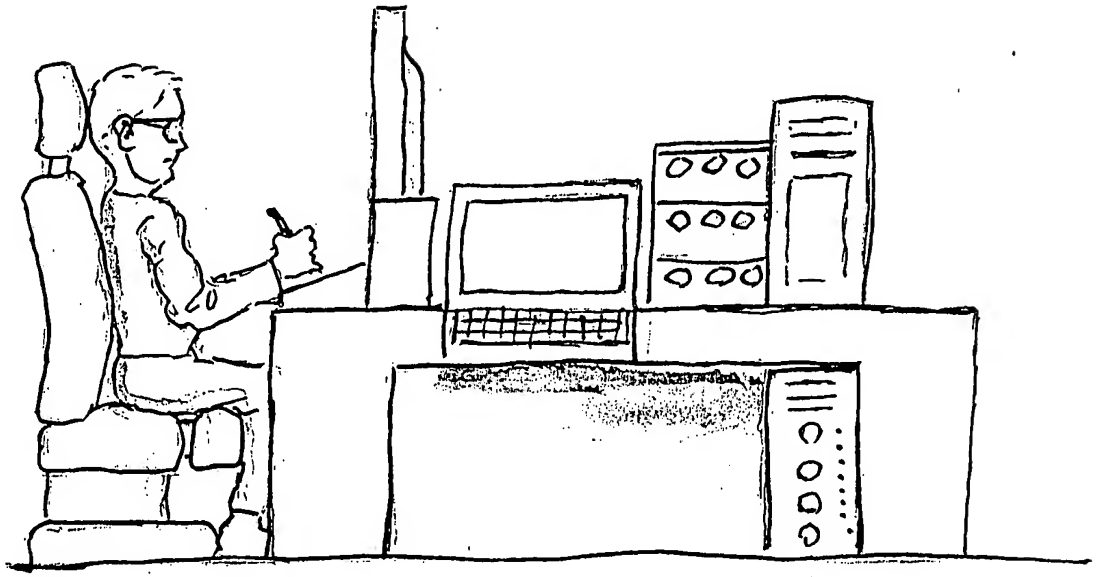
VDRE - DEVICE
SIDE VIEW
DRAWING (2)



DL
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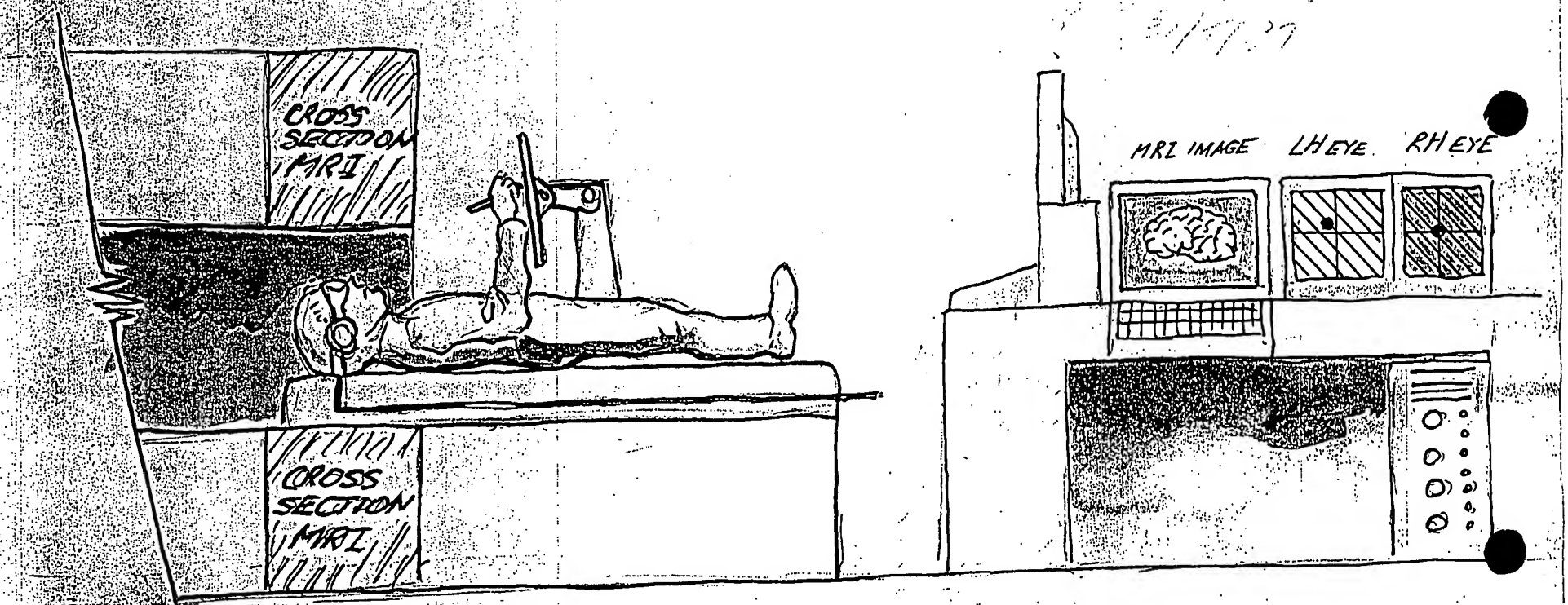
VORE - DEVICE

INTEGRATION WITH MRI MACHINE
DRAWING (3)



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VORED

ADHD PATIENT UNDERGOING PHONOLOGICAL - LEFT TO RIGHT TREATMENT

DRAWING (4)